

<p align="center">6 FIRE DEBRIS ANALYSIS</p>	<p align="center">Page 1 of 13</p>
<p align="center">Division of Forensic Science</p> <p align="center">TRACE EVIDENCE PROCEDURES MANUAL</p>	<p align="center">Amendment Designator:</p>
	<p align="center">Effective Date: 31-March-2003</p>
<p align="center">6 FIRE DEBRIS ANALYSIS</p> <p>6.1 Analytical Approach</p> <p>6.1.1 Barcode container labels will be affixed to the containers, as appropriate, generally at the conclusion of the analysis due to the destructive nature of heat upon the labels.</p> <p>6.1.2 Generate one or more Fire Debris Worksheets (Appendix 19).</p> <p>6.1.3 If the RFLE requests analysis for alcohol or other extremely volatile compounds OR the examiner has reason to suspect alcohol, acetone or other volatiles which may be masked by the extraction solvent, do not open the container. Proceed with ¶ 6.3, Ambient Headspace analysis.</p> <p>6.1.4 Otherwise, briefly open each container, make a gross visual inspection and record a description of the contents. Do not intentionally smell the contents of the container while observing the contents but do make a notation of any unavoidable odor of the contents.</p> <p>6.1.5 If a suspected nonaqueous liquid is present, test to confirm its nonaqueous nature. A nonaqueous liquid will be immiscible with water. For this purpose, the term “aqueous” applies to those liquids that are either water or are liquids that are miscible with water (e.g., alcohols). An aqueous liquid (water) will need to be extracted by the Solvent Extraction procedure, ¶ 6.4, the Dynamic Adsorption/Elution procedure, ¶ 6.5, or the Passive Adsorption/Elution procedure, ¶ 6.6. A nonaqueous liquid or an aqueous liquid (e.g., alcohols) may be injected directly into the gas chromatograph. See Direct Injection procedure, ¶ 6.2.</p> <p>6.1.6 It may be necessary to determine if an unknown liquid sustains a flame. This determination would only be necessary when a non-routine or otherwise unusual liquid is encountered. Attempt to ignite a small amount of the liquid on a watch glass in a hood and record the results on the Fire Debris Worksheet.</p> <p>6.1.7 If the sample contains enough petroleum product to give an unavoidable strong odor, resists heating (e.g., insulation), or when a distinction is needed between fuel oil #1 and fuel oil #2/diesel fuel petroleum products, then solvent extraction is preferred.</p> <p>6.1.8 If a latent prints examination is requested on a bottle or other container and no nonaqueous liquid is present, a solvent extraction of the interior should be performed using caution while wearing gloves or holding the item with tongs or forceps.</p> <p>6.1.9 Any sample extract vials generated during analysis are returned in the can, or other container, corresponding to their particular item.</p> <p>6.1.10 GC-FID sample chromatograms are compared to GC-FID known standard chromatograms according to retention times and overall patterns. The GC-MS is used for extracted ion chromatography (EIC), also known as mass spec ion profiling (MSIP), when deemed appropriate by the individual examiner.</p> <p>6.1.11 Safety Considerations</p> <p>Intentional inhalation of the odor of the contents of items for fire debris analysis is prohibited due to the potential health concerns related to this activity.</p> <p>6.1.12 Minimum Standards and Controls</p> <p>6.1.12.1 Carbon disulfide (CS₂) - A.C.S. Reagent Grade or equivalent that passes specified purity testing. Each new bottle or lot of carbon disulfide must be tested prior to its use in casework. Approximately 5 ml of the new solvent is evaporated to a few drops. 1 µl of this evaporated solvent is injected into the gas chromatograph. If the resulting chromatogram has no significant peaks which interfere with the</p>	

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	analysis, then the solvent is available for use in casework. The chromatogram is labeled with: manufacturer, lot number, start volume, end volume and is placed in a file for permanent storage.	
6.1.12.2	Pentane (C ₅) - Trace Analysis Grade at or below the ppb level or equivalent that passes specified purity testing. Each new bottle or lot of pentane must be tested prior to its use in casework. Approximately 500 ml of the new solvent is evaporated to a few drops. 1 µl of this evaporated solvent is injected into the gas chromatograph. If the resulting chromatogram has no significant peaks which interfere with the analysis, then the solvent is available for use in casework. The chromatogram is labeled with: manufacturer, lot number, start volume, end volume and is placed in a file for permanent storage.	
6.1.12.3	A blank run(s) is conducted on each GC daily (if in use). The blank may consist of either an injection of CS ₂ or C ₅ or an injection of the syringe with no solvent, at the examiner's discretion. When a satisfactory chromatogram is obtained, one which contains no significant peaks that interfere with the analysis, then the instrument is ready for case work. The blanks will be viewed on screen and will not be retained. When manual injections are to be made, the calibration standard or case standard, as appropriate must be injected on the GC prior to running case samples. This standard will be printed and included in the appropriate case file(s).	
6.1.12.4	When the autosampler is used, there shall be at least one blank between each sample on an overnight run and one standard injected at the beginning and end of the run. At least one of the standards injected on an overnight run shall be the calibration standard. The blanks are checked visually on the screen and are not retained. The standards are also checked visually on the screen; a calibration standard chromatogram is printed and will be used as part of case file documentation for items in that run.	
6.2	Direct Injections	
6.2.1	Purpose	
	When a whole nonaqueous liquid is obtained a direct injection may be performed. The purpose of a direct injection is to introduce a nonaqueous whole liquid directly into the gas chromatograph (GC).	
6.2.2	Minimum Standards and Controls	
6.2.2.1	A small amount, determined by the examiner, should be injected to ensure that the gas chromatograph is not overloaded.	
6.2.3	Analytical Procedures	
6.2.3.1	Whole nonaqueous liquid samples can first be injected directly into a gas chromatograph (GC) or subsequently the gas chromatograph/mass spectrometer (GC/MS).	
6.2.3.2	Alternatively, whole nonaqueous liquid samples may be diluted with either pentane or carbon disulfide and injected directly into the GC or GC/MS.	
6.2.4	References	
6.2.4.1	Midkiff, Charles R. "Arson and Explosive Investigation," Forensic Science Handbook, Volume 1, Prentice-Hall, Inc., 1982, pages 227-228.	

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<p>6.3 Ambient Headspace</p> <p>6.3.1 Purpose</p> <p>If a sample contains highly volatile components, these components will be in the vapor state at room temperature. The purpose of an ambient headspace extraction is to sample volatile components present in the air space above the debris. A portion of this vapor sample is injected directly into the gas chromatograph (GC).</p> <p>Special considerations that should be noted with this extraction technique:</p> <p>6.3.1.1 May be affected by the presence of water in the sample, particularly if the compound of interest is miscible with water.</p> <p>6.3.1.2 Produces a disproportionate representation of low boilers (highly volatile) in the headspace i.e., swamping of headspace with more volatile components producing an incomplete pattern <u>OR</u> accelerant mixtures may be masked by the presence of only the most volatile components.</p> <p>6.3.1.3 Must follow-up with a more comprehensive recovery method such as solvent extraction or adsorption-elution if more complex hydrocarbon mixtures are to be identified.</p> <p>6.3.2 Minimum Standards and Controls</p> <p>6.3.2.1 Avoid conducting headspace analysis unless a sufficient block of time within a two day period exists to perform headspace GC injection; headspace GC/MS injections, if needed; and follow-up extractions via another method, if needed.</p> <p>6.3.2.2 Use a new disposable syringe for each sample and standard run.</p> <p>6.3.2.3 Ensure that the GC has been through a blank run prior to injecting and between injections if any peaks were present in previous runs. These blank runs must be satisfactory before injecting samples.</p> <p>6.3.2.4 A syringe/room air blank shall be run.</p> <p>6.3.3 Analytical Procedures</p> <p>6.3.3.1 Punch a small hole in the lid of the container and cover the hole with tape.</p> <p>6.3.3.2 Using a disposable syringe that has been flushed with room air numerous times, draw off about 1 ml of vapor and promptly cover the hole with tape.</p> <p>6.3.3.3 Inject the vapor sample directly into the GC. Generally the Carbowax column and standard polar conditions should be used. In some instances a nonpolar dimethylpolysiloxane column and fire debris conditions will be used.</p> <p>6.3.3.3.1 If no significant or identifiable peaks are present and the requested examination was for accelerants or petroleum products, continue with another recovery method.</p> <p>6.3.3.3.2 If no significant or identifiable peaks are present and the requested examination was for alcohol or other volatiles only, then write a report.</p> <p>6.3.3.3.3 If a peak(s) is present, run a standard(s), as a vapor, using the headspace library or single component retention times in the Reference Collection as a guideline.</p> <p>6.3.3.3.3.1 Inject the vapor sample directly into the GC/MS.</p>	

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6.3.3.3.2 Run the appropriate standard(s), as a vapor sample.		
6.3.4	References	
6.3.4.1	Caddy B., Smith F. P., Macy J.: Methods of Fire Debris Preparation for Detection of Accelerants: Forensic Science Review 3: 57; 1991.	
6.3.4.2	Midkiff, Charles R. "Arson and Explosive Investigation," Forensic Science Handbook, Volume 1, Prentice-Hall, Inc., 1982, pages 230-231.	
6.3.4.3	Standard Practice for Sampling of Headspace Vapors from Fire Debris Samples: ASTM Method E 1388-90.	
6.4	Solvent Extraction	
6.4.1	Purpose	
	<p>The purpose of a solvent extraction is to remove petroleum products which may be present in the debris. This extract may be concentrated by evaporation, if needed, and a portion injected into the gas chromatograph (GC) or gas chromatography/mass spectrometry (GC/MS).</p> <p>Special considerations that should be noted with this extraction technique:</p>	
6.4.1.1	Many components from the debris are also soluble in pentane and these may interfere with chromatogram interpretation. Generally, solvent extraction is not preferred for the extraction of clothing, leather goods and melted plastics due to these interferences.	
6.4.2	Safety Considerations	
6.4.2.1	Pentane (C ₅) should be kept from heat, heat sources and sources of ignition.	
6.4.2.2	Perform extractions in a fume hood.	
6.4.3	Minimum Standards and Controls	
6.4.3.1	Previously cleaned glassware is rinsed with pentane prior to use.	
6.4.3.2	With this procedure a solvent blank must be run at the same time as the debris extraction. The same volume of pentane decanted off for the extraction should be used for the solvent blank and this solvent blank should be reduced to the same volume as the sample. For example, if 80 ml of pentane is used to extract the debris and only 50 ml is decanted off and the extract is evaporated to 2 ml, then use 50 ml of pentane and evaporate to 2 ml for the solvent blank. Compare the solvent blank to the debris extract(s).	
6.4.3.3	If the sample extract is to be concentrated by evaporation, the solvent blank will be evaporated a similar amount.	
6.4.4	Analytical Procedures	
6.4.4.1	Add pentane to the debris. The amount of pentane needed will vary with the amount and kind of debris. Use enough solvent to permit thorough "wetting" of the debris.	
6.4.4.2	Decant the pentane into an evaporating dish or beaker. Filter and concentrate, as necessary.	

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6.4.4.2.1	If two phases are present (i.e. pentane and water), the water may be removed by using Whatman #1PS phase separating paper or a separatory funnel. Alternatively, the solvent layer may be removed with a Pasteur pipette.	
6.4.4.2.1.1	Anhydrous sodium sulfate may be added to absorb any residual water that is present.	
6.4.4.2.2	If only pentane is present, Whatman #1 or #1PS filter paper or a Pasteur pipette with a small plug of glass wool may be used.	
6.4.4.2.3	The amount of concentrating (evaporating) will be based upon the sample. A strong sample (one which possesses a strong odor) may need little evaporation. A sample that is weak or does not possess an apparent petroleum odor should be evaporated down to about 0.5 ml, should the sample allow.	
6.4.4.2.3.1	Alternatively, decant the pentane into an Erlenmeyer flask. Place the flask in a dish of warm water or an ultrasonic cleaner and apply a vacuum to a disposable pipette inserted into a rubber stopper in the neck of the flask. Carefully concentrate the pentane using the above guidelines.	
6.4.4.3	Transfer extract to a labeled vial.	
6.4.4.4	Inject the appropriate volume of pentane directly into the gas chromatograph.	
6.4.4.5	Follow-up with GC/MS as necessary.	
6.4.5	References	
6.4.5.1	Caddy B., Smith F. P., Macy J.: "Methods of Fire Debris Preparation for Detection of Accelerants": Forensic Science Review 3: 57; 1991.	
6.4.5.2	Midkiff, Charles R. "Arson and Explosive Investigation," Forensic Science Handbook, Volume 1, Prentice-Hall, Inc., 1982, pages 230-231.	
6.4.5.3	Stafford, David T. "Fire Investigation. Part II: Laboratory Investigation", Crime Laboratory Digest Vol. 14, No. 1 January 1987.	
6.4.5.4	ASTM Method E 1386-90: Standard Practice for Separation and Concentration of Flammable or Combustible Liquid Residues from Fire Debris Samples by Solvent Extraction.	
6.5 Dynamic Adsorption/Elution		
6.5.1	Purpose	
<p>The purpose of the dynamic adsorption/elution extraction is to remove petroleum products which may be present in the debris and put them into a liquid which can be analyzed via gas chromatography (GC) or gas chromatography/mass spectrometry (GC/MS). Dynamic adsorption/elution, also referred to as the charcoal tube method, is an active process that relies on the volatility of petroleum products. Volatilized petroleum products are removed by heat and a vacuum and are trapped on an in-line charcoal-filled tube. Petroleum products are eluted from the charcoal with a solvent (carbon disulfide) and analyzed.</p> <p>Special considerations that should be noted with this extraction technique:</p>		
6.5.1.1	Samples containing a large amount of petroleum products can exhibit selective adsorption of the components.	

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<div> <div>6.5.1.2</div> <div>If a sample resists heating, such as insulation, this extraction method is not preferred.</div> </div> <div> <div>6.5.1.3</div> <div>This extraction method may not fully recover petroleum products of low volatility. (i.e. Fuel oil #1 and #2 cannot be distinguished by this method.)</div> </div> <div> <div>6.5.2</div> <div>Safety Considerations</div> <div> <div>6.5.2.1</div> <div>Carbon disulfide (CS₂) is a hazardous chemical with respect to both health and safety and must be handled with extreme care. Avoid physical contact with CS₂. Avoid inhalation of CS₂.</div> <div>6.5.2.2</div> <div>CS₂ should be kept from heat, heat sources and sources of ignition.</div> <div>6.5.2.3</div> <div>Perform extractions and elutions in a fume hood.</div> </div> </div> <div> <div>6.5.3</div> <div>Minimum Standards and Controls</div> <div> <div>6.5.3.1</div> <div>With this procedure, an extraction blank must be run at all times while samples are being extracted. The extraction blank will serve as a monitor of the room air, the charcoal tube and the carbon disulfide and will be extracted using the same procedure as for the evidentiary samples. A copy of the extraction blank will be placed in each case file extracted that day.</div> <div>6.5.3.2</div> <div>If the sample extract is to be concentrated by evaporation, the extraction blank will be evaporated a similar amount.</div> <div>6.5.3.3</div> <div>A new charcoal tube is used for each case item.</div> <div>6.5.3.4</div> <div>Thermometers will be regularly checked to ensure they are functioning properly. (Appendix 16)</div> </div> </div> <div> <div>6.5.4</div> <div>Analytical Procedures</div> <div> <div>6.5.4.1</div> <div>The sample must be in a paint can.</div> <div>6.5.4.2</div> <div>A minimal amount of water may be added to samples containing clothing articles. This is to assist in more even heating of the debris. Water will not be added to any other type of debris without prior approval of the Section Chief.</div> <div>6.5.4.3</div> <div>Puncture openings in the lid of the can for a thermometer and a charcoal tube. The charcoal tube will be attached to a vacuum line to draw off and concentrate the sample vapors. The tip of the thermometer must be inserted into the approximate center of the can as much as is practicable. The thermometer must NOT touch the sides or bottom of the can.</div> <div>6.5.4.4</div> <div>Heat the can to approximately 100° C and hold for roughly 15 minutes.</div> <div> <div>6.5.4.4.1</div> <div>As soon as the cans are cool, place a piece of tape over the thermometer and charcoal tube holes. Tape over these holes with DFS evidence tape when sealing the cans at the completion of the analysis for return to the submitting agency.</div> </div> <div>6.5.4.5</div> <div>Transfer the charcoal to an extraction vial and add approximately 1-2 ml of carbon disulfide. The system blank should be treated the same as the samples.</div> <div>6.5.4.6</div> <div>If necessary, the carbon disulfide can be concentrated using a disposable pipette attached to a vacuum line to pull off the vapors above the extract, by using house air with, or without, a microevaporator, or by allowing the uncapped vials to sit in the hood.</div> </div> </div>	

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6.5.4.7	Inject a portion of the carbon disulfide extract, usually 1ul, directly into the gas chromatograph.	
6.5.4.8	If the autosampler is to be used, agitate the vial, and transfer the extraction solution to a labeled autosampler vial fitted with an insert via disposable pipette. If desired, a drop of deionized water may be placed on top of the extract to slow down evaporation.	
6.5.4.8.1	Autosampler vials will be de-capped and re-capped if the extracts are to be maintained in these vials for storage of longer than 1 day.	
6.5.4.9	Follow-up with GC/MS as necessary.	
6.5.5	References	
6.5.5.1	Caddy B., Smith F. P., Macy J.: Methods of Fire Debris Preparation for Detection of Accelerants: Forensic Science Review 3: 57; 1991.	
6.5.5.2	Sandercock, P. M. L. "Comparison of Passive Charcoal Adsorption with a Dynamic Charcoal Adsorption Technique" Canadian Journal of Forensic Science, Vol. 27, No. 3, 1994.	
6.5.5.3	Stafford, David T. "Fire Investigation. Part II: Laboratory Investigation", Crime Laboratory Digest Vol. 14, No. 1 January 1987.	
6.5.5.4	Material Safety Data Sheet for Carbon Disulfide.	
6.5.5.5	Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris Samples by Dynamic Headspace Concentration: ASTM Method E 1413-95.	
6.6	Passive Adsorption/Elution	
6.6.1	Purpose	
	<p>The purpose of the passive adsorption/elution extraction is to remove petroleum products which may be present in the debris and put them into a liquid which can be analyzed via gas chromatography (GC) or gas chromatography/mass spectrometry (GC/MS). Passive adsorption/elution is a headspace concentration method, also referred to as the charcoal strip method, which relies on the volatility of petroleum products. Volatilized petroleum products are removed by heat without a vacuum and are trapped on a charcoal strip. Petroleum products are eluted from the charcoal with a solvent (carbon disulfide) and analyzed.</p> <p>Special considerations that should be noted with this extraction technique:</p>	
6.6.1.1	Samples containing a large amount of petroleum products can exhibit selective adsorption of the components.	
6.6.1.2	If a sample resists heating, such as insulation, this extraction method is not preferred.	
6.6.1.3	This extraction method may not fully recover petroleum products of low volatility. (i.e. Fuel oil #1 and #2 cannot be distinguished by this method.)	
6.6.2	Safety Considerations	
6.6.2.1	Carbon disulfide is a hazardous chemical with respect to both health and safety and must be handled with extreme care. Avoid physical contact with CS ₂ . Avoid inhalation of CS ₂ .	
6.6.2.2	CS ₂ should be kept from heat, heat sources and sources of ignition.	

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6.6.2.3	Perform elutions in a fume hood.	
6.6.2.4	Care should be exercised when removing cans from ovens. Cans must be allowed to cool to approximately room temperature prior to opening for removal of charcoal strip.	
6.6.3	Minimum Standards and Controls	
6.6.3.1	For each day that samples are prepared using this method, an extraction blank will be prepared and extracted. To prepare an extraction blank, one pre-cut charcoal strip will be extracted using the same procedure as for the evidentiary samples. A copy of the extraction blank will be placed in each case file extracted that day.	
6.6.3.2	If the sample extract is to be concentrated by evaporation, the extraction blank will be evaporated a like amount.	
6.6.3.3	A new charcoal strip is used for every case item.	
6.6.3.4	Ovens will be regularly checked to ensure they are functioning properly. (Appendix 16)	
6.6.4	Analytical Procedures	
6.6.4.1	The sample must be in a paint can.	
6.6.4.2	Suspend a pre-cut charcoal strip inside the evidence container via a paper clip and magnet. Close the container.	
6.6.4.3	Samples containing water may create sufficient pressure when heated to cause lids to “pop” open. When water is observed, lids should be taped down in order to prevent this.	
6.6.4.4	Allow the can to sit at 75 ⁰ C for approximately 16 hours.	
6.6.4.5	Remove the cans from the oven and allow them to cool, if necessary.	
6.6.4.6	Open the lid and using forceps, or a similar tool, remove the suspended strip. Place one strip into a fully labeled vial.	
6.6.4.7	Add no more than 500uL of CS ₂ to the vial.	
6.6.4.8	Inject a portion of the carbon disulfide extract, usually 1ul, directly into the gas chromatograph.	
6.6.4.9	If the autosampler is to be used, agitate the vial, and transfer the extraction solution to a labeled autosampler vial fitted with an insert via disposable pipette. If desired, a drop of distilled water may be placed on top of the extract to slow down evaporation.	
6.6.4.9.1	Autosampler vials will be de-capped and re-capped if the extracts are to be maintained in these vials for storage of longer than 1 day.	
6.6.4.10	Follow-up with GC/MS as necessary.	
6.6.5	References	
6.6.5.1	ASTM E 1412-95, Standard Practice for Separation and Concentration of Ignitable Liquid Residues from Fire Debris by Passive Headspace Concentration.	

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6.6.5.2	Newman, R.T., Lothridge, K. And Dietz, W., “The Use of Activated Charcoal Strips for Fire Debris Extractions by Passive Diffusion Part 1: The Effects of Time, Temperature, Strip Size, and Sample Concentration,” <i>Journal of Forensic Sciences</i> , Vol. 41, No. 3, May 1996, Pp. 167-176.	
6.6.5.3	Dietz, W.R., “Improved Charcoal Packaging for Accelerant Recovery by Passive Diffusion,” <i>Journal of Forensic Sciences</i> , Vol. 36, No. 1, Jan. 1991, Pp 111-121.	
6.6.5.4	Material Safety Data Sheet for Carbon Disulfide.	
6.6.5.5	ASTM E-752-89 Standard Practice for Safety and Health Requirements Relating to Occupational Exposure to Carbon Disulfide.	
6.7 GC-MS Extracted Ion Chromatography (EIC)		
6.7.1	Purpose	
	Extracted ion chromatography, or ion profiling, is especially useful when samples show a high degree of debris interference.	
6.7.2	Analytical Procedures	
6.7.2.1	Each day that the GC-MS is used for case samples, the fire debris calibration standard (1:1 whole gasoline and whole diesel fuel) or a case standard, as appropriate, must be run prior to case samples. This will serve as a check of the resolution and sensitivity of the instrument.	
6.7.2.2	Systematic naming shall be used for standard fire debris methods with the autosampler: AUTO + injection volume + split. Systematic naming shall be used for standard fire debris methods using manual injection: MANL + split.	
6.7.2.3	The injection volume and split will vary for the AUTO and MANL methods, but the temperature and mass spec acquisition parameters will be the same. (See Appendix 8, Attachment 1)	
6.7.2.3.1	These methods will NOT be changed by individual examiners.	
6.7.2.4	Systematic naming and content shall be used for standard fire debris macros.	
6.7.2.4.1	These macros will NOT be changed by individual examiners.	
6.7.2.5	The Library Summary Report may be generated to give an idea of the types or classes of compounds present when many peaks are present in the TIC.	
6.7.2.6	A portion of the extract or whole liquid is injected into the GC/MS.	
6.7.2.7	Fire debris samples that are taken to the GC-MS for either identification of single peaks or extracted ion chromatography (EIC) that have been run on the GC-FID first and determined to have no interference in the region of interest do not need to have the extraction blank repeated on the GC-MS.	
6.7.2.8	The data handling system is used to extract selected ion chromatograms for each compound type. Two or more characteristic ions are summed to enhance signal-to-noise and decrease interference by extraneous compounds that contain only one of the ions. The following ions are used for the individual classes of hydrocarbons:	
	Alkanes: Ions 57, 71, 85, and 99	
	Aromatics: Ions 91, 105, 119, 133	
	Indanes: 117, 131	

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<p>Olefins/Cycloparaffins: 55, 69, 83 Polynuclear aromatics (PNAs): 128, 142, 156</p> <p>6.7.2.9 Extracted ion chromatograms of the unknown sample are visually compared against the corresponding extracted ion chromatograms from standard samples.</p> <p>6.7.3 References</p> <p>6.7.3.1 ASTM E 1618-97, Standard Guide for Identification of Ignitable Liquid Residues in Extracts from Fire Debris Samples by Gas Chromatography-Mass Spectrometry.</p> <p>6.7.3.2 Newman, R., Gilbert, M., Lothridge, K. "GC-MS Guide to Ignitable Liquids," CRC Press, 1998, pages 1-5.</p>		
6.8 Identification Criteria		
<p>6.8.1 Possible reported results include: No Identification, Identification or Characteristics.</p> <p>6.8.1.1 Used less frequently, but still appropriate in some circumstances, would include: Consistent.</p> <p>6.8.2 No Identification - The sample does not contain sufficient peaks/pattern that match reference standards on file. The report would generally read: No petroleum products were identified in the Item __ extract.</p> <p>6.8.3 Identification - The sample contains sufficient peaks/pattern matching a reference standard on file. There is no set number assigned to the amount of peaks that must match. It is the overall pattern that is compared to the reference standard. This match or identification is based upon the examiner's training and experience. The report would generally read: The Item __ extract contained a _____ petroleum product.</p> <p>6.8.4 Characteristics - The sample contains some peaks/pattern (has indications of) a reference standard on file, but due to being weak or having interferences, a definitive identification cannot be made. The report would generally read: The Item __ extract had characteristics of a _____ petroleum product. Sample condition precluded a more definitive determination.</p>		
6.9 Documentation		
<p>6.9.1 As a minimum, each case file will include a fire debris worksheet(s) (Appendix 19), a GC Conditions Sheet (Appendix 19), a GC/MS conditions sheet (Appendix 19) or method file printout (as appropriate), one or more chromatograms for each Item of evidence analyzed and each standard necessary to support the conclusions, an extraction blank, a concentrated extraction blank, as appropriate, and a calibration standard.</p> <p>6.9.2 After checking the blanks and standards, initial the fire debris worksheet(s) in the space provided.</p> <p>6.9.2.1 If only GC-FID was used, then initialing the space on the fire debris worksheet signifies that the GC-FID blanks and standards were okay.</p> <p>6.9.2.2 If using both GC-FID and GC-MS, then initialing the space on the fire debris worksheet signifies that both the GC-FID and GC-MS blanks and standards were okay.</p> <p>6.9.3 Each case sample shall be checked at a minimum on the screen at the lowest mV setting as practicable to ensure that no other patterns are present that should be addressed. In lieu of printing, notations may be made on these chromatograms signifying this review. For instance, "✓ okay to 18.3 min at 10 mV" or "baseline and 18.3 min ✓ okay".</p>		

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<p>6.9.4 The minimum requirements for labeling chromatograms is as follows:</p> <ul style="list-style-type: none"> • Case Number • Item Number • Handwritten Examiner's Initials • GC used or type of column (unless present on chromatogram) • Injection volume • Injection solvent • Note if the original sample has been concentrated • If standard has been diluted, note solvent used <p>6.9.5 To the maximum extent possible, case samples and standards need to be at least 75% on scale or greater in the printed chromatogram.</p> <p>6.9.6 Blanks shall be printed at the same mV value or less than the case sample chromatograms.</p> <p>6.9.7 When identifying single components such as alcohol, acetone, pinene, etc, retention time data for samples and standards are needed from at least the polar GC column along with retention time and spectral data from the GC/MS. For the identification of paraffins, the use of nonpolar GC column retention times along with retention time and spectral data from the GC/MS is acceptable.</p> <p>6.9.8 Generally speaking, GC-FID single component peaks that are approximately two times greater than the mV of the 1,2,4-TMB peak for the current month's QC which also elute at a retention time of 7.0 minutes or less will be pursued to determine if they are significant to the case. This does not automatically mean that "larger" peaks above 7.0 minutes or "smaller" peaks below 7.0 minutes are automatically excluded from this process. Each case must be evaluated individually and a decision made by the examiner to pursue or not pursue peaks based upon that case information.</p> <p>6.9.9 For EIC: at a minimum, include the following:</p> <ul style="list-style-type: none"> • A full page landscape format TIC covering the entire sample/standard run time • A single page portrait format printout of a series of five summed extracted ion profiles (EIPs) covering the entire sample/standard run time, including <ul style="list-style-type: none"> ○ Alkanes (57 + 71 + 85 + 99) ○ Simple Aromatics (91 + 105 + 119 + 133) ○ Indanes (117 + 131) ○ Cycloparaffins/Alkenes (55 + 69 + 83) ○ Polynuclear aromatics (128 + 142 + 156) • A single page portrait format printout of the series of five summed extracted ion profiles covering the sample/standard run time of interest. • GC-MS Conditions Sheet (Appendix 19) 	
<p>6.10 Report Wording</p> <p>To the maximum extent possible, report wording will be selected from the following:</p> <p>6.10.1 No petroleum products were identified in the Item _____ extract.</p> <p>6.10.2 No petroleum products were identified in the Item _____ or _____ extracts.</p> <p>6.10.3 The Item _____ extract contained a _____ petroleum product.</p> <p>6.10.4 The Item _____ extract contained a _____ petroleum product which can be found in, but is not limited to, some _____ (give examples of general product types).</p>	

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<p>6.10.5 The Item _____ and _____ extracts each contained a _____ petroleum product.</p> <p>6.10.6 The Item _____ extract contained a mixture of a _____ petroleum product and a _____ petroleum product.</p> <p>6.10.7 The Item _____ and _____ extracts each contained a mixture of a _____ petroleum product and a _____ petroleum product.</p> <p>6.10.8 The combined Item _____ and _____ extracts contained a mixture of a _____ petroleum product and a _____ petroleum product.</p> <p>6.10.9 The combined Item _____ and _____ extracts contained a mixture of a _____ petroleum product and a _____ petroleum product. The _____ petroleum product can be found in, but is not limited to, some _____ (give examples of general product types).</p> <p>6.10.10 The Item _____ nonaqueous liquid was identified as a _____ petroleum product.</p> <p>6.10.11 The Item _____ and _____ nonaqueous liquids were each identified as a _____ petroleum product.</p> <p>6.10.12 The Item _____ extract had characteristics of a _____ petroleum product. Sample condition precluded a more definitive determination.</p> <p>6.10.13 Due to the nature of heavy oil/lubricant petroleum products, there is some flexibility in how they may be reported. The following statement, which is weaker than an identification but stronger than characteristics, may be used:</p> <p style="padding-left: 40px;">The Item _____ extract was consistent with containing a heavy oil/lubricant petroleum product.</p> <p>6.10.14 If an aqueous liquid is encountered, report as follows:</p> <p style="padding-left: 40px;">The extract of the Item _____ aqueous liquid contained a _____ petroleum product.</p> <p>6.10.15 The Item _____ extract contained α-pinene, the origin of which could not be determined. It should be noted that α-pinene occurs naturally in some woods and is also found in turpentine.</p> <p>6.10.16 The Item _____ extract contained paraffins.</p> <p style="padding-left: 40px;">6.10.16.1 If physical properties of wax are present:</p> <p style="padding-left: 80px;">The Item _____ extract contained a paraffin wax.</p> <p>6.10.17 Generally speaking the petroleum product categories reported are as follows:</p> <p style="padding-left: 40px;">6.10.17.1 Light, medium or heavy petroleum product, gasoline, mineral spirits, kerosene, fuel oil, fuel oil #2/diesel fuel, heavy oil/lubricant.</p> <p style="padding-left: 40px;">6.10.17.2 A minimum of two (if possible) and maximum of three (if necessary) examples of commercial products would typically be listed for LPP, MPP and MS petroleum products. The examples used most routinely for mineral spirits are: "some paint thinners and charcoal starter fluids".</p> <p style="padding-left: 40px;">6.10.17.3 Certain types of debris (such as leather, newsprint, and carbonless copy paper) are known to give petroleum product patterns on GC and GC/MS. When this type of debris is analyzed and a petroleum product is identified, the following statement should be used:</p>	

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<p>It should be noted that some _____ (ex. leather goods) may contain _____ (ex. fuel oil) petroleum products.</p> <p style="text-align: right;">◆End</p>	